

ALLIANCE
Technologies Corporation

VERIFICATION OF SOLE OR
PRINCIPAL SOURCES OF
DRINKING WATER

Letter Report

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INTRODUCTION

The Sole Source Aquifer (SSA) program was established under Section 1424(e) of the Safe Drinking Water Act (SDWA). This program authorizes the U.S. Environmental Protection Agency (U.S. EPA) to designate an aquifer as the sole or principal source of drinking water in an area.

The Sole Source Aquifer Demonstration Program was established under Section 1427 of the SDWA. This program established a mechanism by which any State, municipal or local government or planning agency may petition the U.S. EPA for a SSA designation for an aquifer over which it has authority or jurisdiction.

The Missoula City County Health Department (MCCHD) has petitioned the USEPA for a SSA designation for the Missoula, Montana Aquifer. The USEPA has contracted Alliance Technologies to provide technical support in determining whether the petitioning document satisfies the criteria specified in Task E: Verification of Sole or Principal Source(s) of Drinking Water of Work Assignment 2-17. The criteria specified in Task E are:

- 1) do the users of aquifer derive more than 50 percent of their water supplies from the aquifer in question; and
- 2) are there hydrogeologic, legal/institutional, and/or economic constraints which make development of alternate water supplies infeasible.

Section 1 of this document deals with the determination of aquifer usage of the Missoula County residents. Section 2 examines the feasibility of developing alternate water supplies given the hydrogeologic, legal/institutional and/or economic constraints of the Missoula area.

SECTION 1

DETERMINATION OF AQUIFER USAGE

Missoula County, Montana is located in western Montana and forms part of the Montana-Idaho boundary as illustrated in Figure 1. The physiography of the county consists of mountain ranges and intermontaine depressions which are filled with glacial till and/or alluvial sediments.

The Missoula Aquifer is located in the Missoula-Ninemile Valley (Figure 2). The Missoula-Ninemile Valley is an intermontaine depression. The bedrock under the Valley consists of the Precambrian Belt Supergroup marine sedimentary rocks. These rocks are impermeable and yield water from fracture systems only.

The Renova Formation is a Tertiary deposit of clays, silts, sand, gravel and volcanic ash. The Renova Formation lies unconformably over the Precambrian Supergroup Rocks in the area beneath the Missoula Aquifer. These strata range in thickness from 2,000 to 2,500 feet in the Missoula Valley.

The Missoula Aquifer overlies the Renova Formation and forms the valley floor. The Missoula Aquifer is composed of three stratigraphic units. The uppermost unit, known as unit one, is a fluviially deposited strata which consists of boulders, coarse cobbles, sand and silt. This unit ranges in thickness from 10 to 30 feet. The water content in this unit ranges from fully saturated to unsaturated. When fully saturated, unit one exhibits a transmissivity range of 103,000 to 1,710,000 gpd/ft². The percentage of water saturation this unit exhibits is dependent on its location in the valley and the time of year. Unit two is a silty sandy clay with lenses of sand and gravel. The finer materials found in this unit are believed to be deposited by a Plistocene glacial lake which formed in the valley. Unit two is approximately 40 feet thick. The transmissivity of unit two is approximately an order of magnitude less than unit one. Unit three ranges in thickness from 50 to 150 feet. This unit is composed primarily of coarse grained sediments

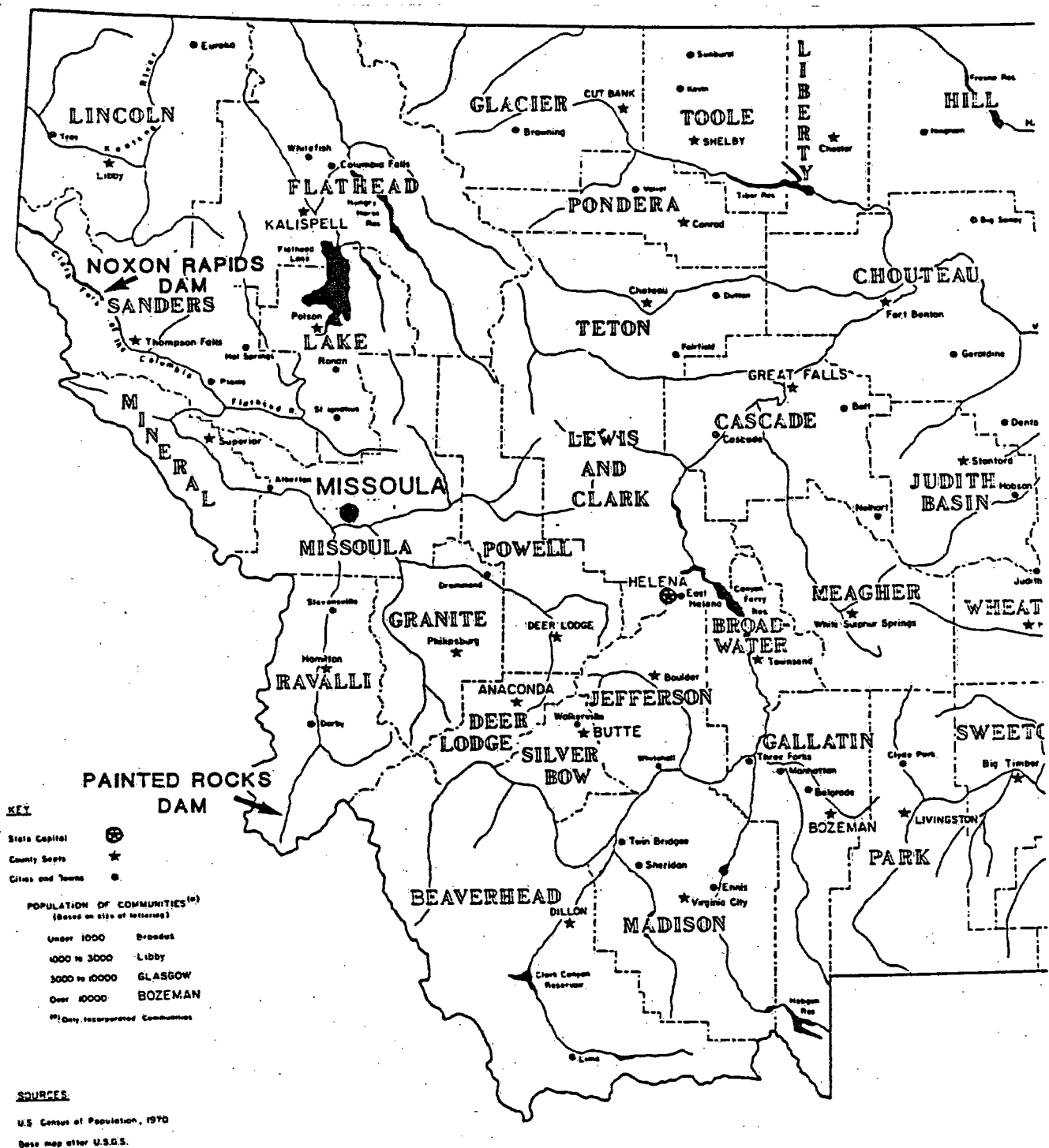


Figure 1. Western Montana general locations.

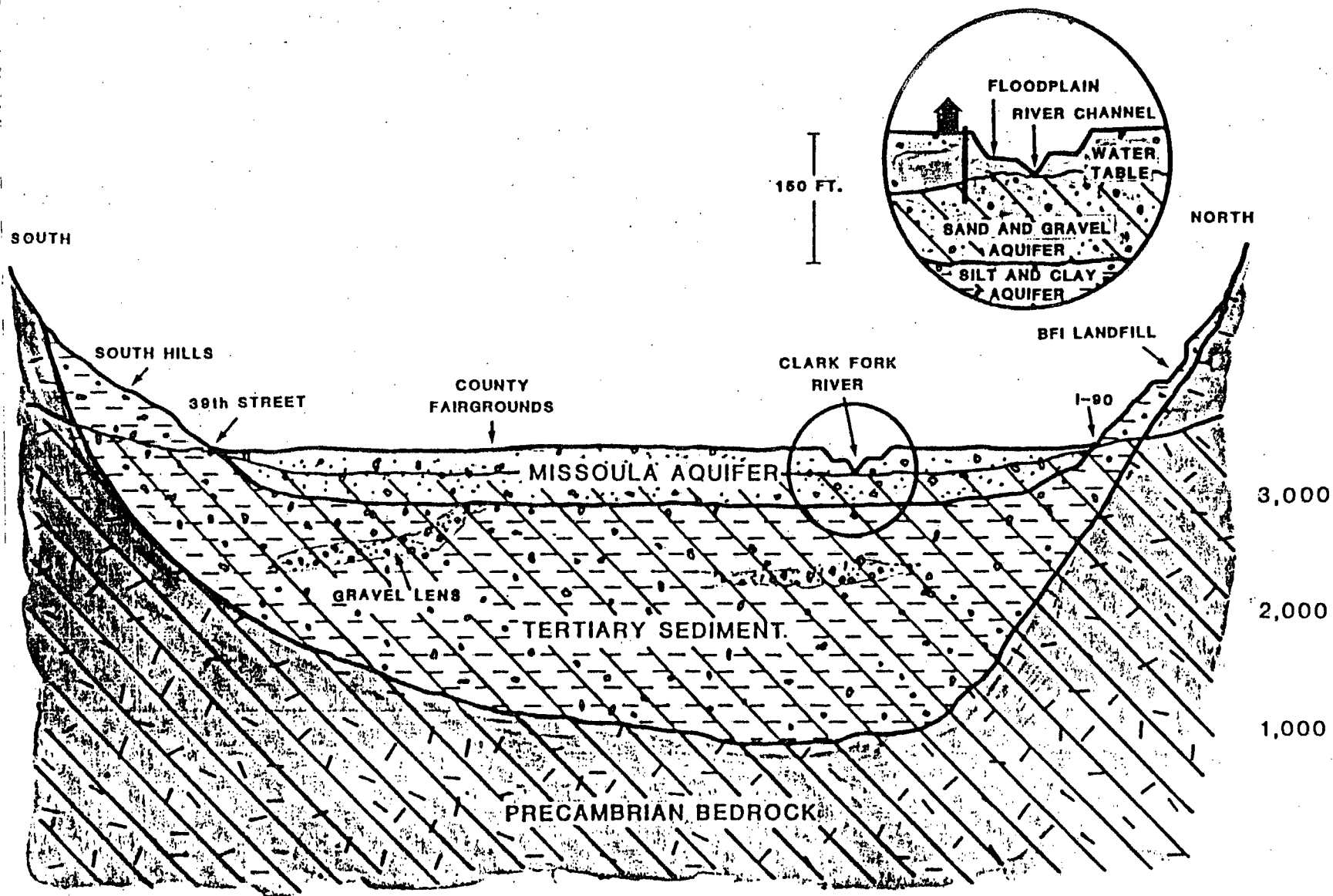


Figure 2. Cross section of Missoula Valley.

interlayered with thin layers of fine grained sediments. This unit is hydraulically connected to the upper two units and behaves as an unconfined aquifer. Unit three is fully saturated and exhibits transmissivity values similar to unit one (saturated). Unit three is ideally suited for water supply. Most wells in the valley are completed in this lower portion of the Missoula Aquifer.

The Mountain Water Company (MWC) is a privately-owned company which supplies water to almost all of the residents of the City of Missoula (population 33,388)*. The MWC also provides water service to more than 11,000 residents outside the city limits. The total customer base of the MWC is 44,755 people of the 76,016 residents of Missoula County, or 59 percent of the County population. The MWC receives 100 percent of its water production from wells completed in the Missoula Aquifer.¹

The smaller Clark Fork Water Company (CFWC) supplies water to 2,329 residents in Missoula County representing about 3 percent of the Missoula County population. The CFWC draws 100 percent of its water supply from the Missoula Aquifer. There are approximately 13,000 residents in Missoula County who supply their own water needs using water from the Missoula Aquifer, representing about 17 percent of the County population.

Alliance estimates that roughly 79 percent of the population of Missoula County derive their water from the Missoula Aquifer. The MWC supply network alone provides for more than 50 percent of the water use in the County. Alliance therefore concludes that the Missoula petition satisfies the first requirement of aquifer usage as specified in Task E of WA No. 2-17.

*U.S. Census 1980, Census Tract Data, Missoula County, Montana.

REFERENCES

1. Sole Source Aquifer Petition for the Missoula Valley Aquifer. Environmental Health Division of the Missoula City County Health Department.
2. Hydrogeology of Water Resources of the Missoula Basin, Montana. Geldon A.L.
3. A Ground Water Evaluation of the Ninemile Valley in Missoula County, Western Montana. Barclay.

SECTION 2

EVALUATION OF ALTERNATE WATER SUPPLIES

2.1 EVALUATION OF WATER RESOURCES

This section examines alternate water supply sources to determine if they contain recoverable water in sufficient quantities to satisfy the water needs for the Missoula community. This evaluation is conducted to determine the availability of alternate water supplies in the event of contamination of the Missoula Aquifer, rendering it unusable.

There are three sources of ground water in the Missoula Valley. These sources are, in order of decreasing age: fractured Precambrian Belt Supergroup rocks; the Renova equivalent sediments; and the coarse alluvium exposed at the surface of the valley floor. This coarse alluvium is referred to as the Missoula Aquifer and is the primary water supply for Missoula City and County (Figure 2).

The Precambrian Rock is impermeable and yields water from fractured systems only. The specific capacity of the formation is approximately 0.11 gallons per minute per foot of drawdown (Geldon 1979). Wells completed in this formation have yielded between one and seventeen gpm(1). These yields are orders of magnitude smaller than the Missoula Aquifer. This aquifer system is not a viable alternative as a water supply for the Missoula Community.

The Renova Equivalent formation is a discontinuous sand and gravel aquifer found beneath the Missoula Aquifer. These discontinuous lenses of sand and gravel are usually confined by silts and clays and generally yield water under artesian conditions. The average yield of wells completed in this formation is 11.3 gpm (Barclay 1986). This low yield coupled with the discontinuous nature of the formation make this aquifer unsuitable as a replacement for the Missoula Aquifer.

Alliance agrees with the conclusion of the petitioners that these alternative ground water sources are inadequate replacements for the Missoula Aquifer.

The Bitterroot Valley alluvial sediments appear to be a potential viable alternative ground water source. The size and composition of this aquifer make it a candidate for development as an alternative water supply.

The petitioning document lists the following surface waters as potentially viable alternatives to the Missoula Aquifer: the Clark Fork River; the Bitterroot River; Rattlesnake Creek; and O'Brien Creek (Figure 3). All of these options, with the exception of Rattlesnake Creek, could serve as a single source replacement for the Missoula Aquifer. The flow volume of Rattlesnake Creek is insufficient to provide for all of the water needs of the Missoula residents. This source would have to be developed in conjunction with another source to provide an adequate water supply, for the residents of Missoula County.

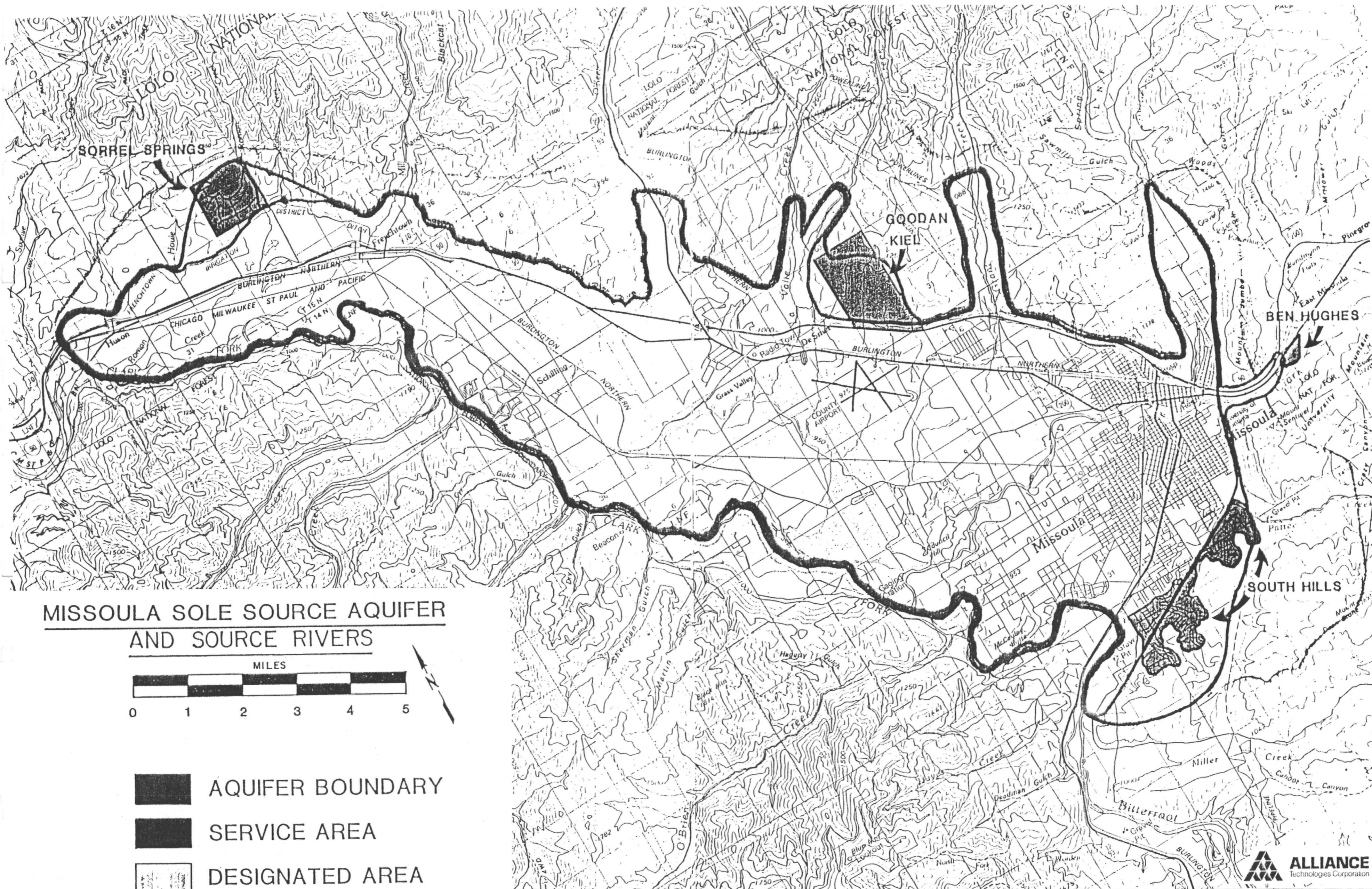
One alternate water supply scenario which the petitioners did not explore is the purchase of water from the Hungry Horse Reservoir and the use of Flathead River and Clark Fork River as conduits for this supply. The cost of developing a treatment plant for water taken from the Clark Fork River also applies to this option.

In conclusion, there are a number of potentially viable alternative water supplies which are available for development. The availability of these supplies from a legal standpoint and the economic cost of developing these supplies are covered in the following sections of this report.

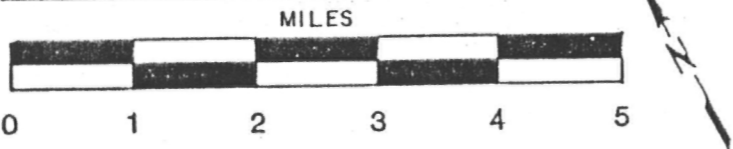
2.2 INSTITUTIONAL ANALYSIS OF ALL POTENTIAL DRINKING WATER SOURCES



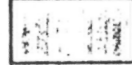
The State of Montana has developed legal mechanisms that allow the allocation of surface and/or ground water for use. The applicable Montana statutes are: Montana Code Annotated (MCA) Title 85-2-506, MCA Title 85-2-316, and MCA Titles 85-2-601 through 605. Alliance has reviewed outstanding water rights claims to potential water sources and has determined which are legally available and could be allocated to Missoula County for its use.

MCA 85-2-506: Designation of Controlled Ground Water Area, allows the development of a controlled ground water area to protect the quantity and quality of ground water. A controlled ground water area designation can be awarded if any of the following conditions exist in an area:



MISSOULA SOLE SOURCE AQUIFER
AND SOURCE RIVERS



-  AQUIFER BOUNDARY
-  SERVICE AREA
-  DESIGNATED AREA

- withdrawals exceed recharge or are likely to cause a problem in the future
- conflicting ground water uses
- decline or degradation of ground water resources

Two controlled ground water areas exist in Montana. Specific rules and standards have been written for each site. New water rights applications in the designated areas are required to comply to the standards of that particular area.

MCA 85-605: (601-605) and 85-2-316 - Reservation of Surface and Ground Water Supplies, has primarily been used for surface water reservations. The Department (MDNRC) may apply for or assist other agencies or individuals/municipalities may apply for reservation of water for "beneficial water use" and future uses or to maintain an average flow in a river for the entire year

The following surface waters are administratively feasible and currently available as potential drinking water sources for the Missoula Valley:

- 1) Clark Fork River
- 2) Painted Rocks Reservoir using the Bitterroot River as a conduit
- 3) Flathead River/Hungry Horse Reservoir

The Clark Fork River is available to a certain degree for drinking water rights. The Sole Source Aquifer (SSA) petition is somewhat incorrect in referring to this river as having "a temporary closure." More accurately, the Montana Department of Natural Resources and Conservation (MDNRC) temporarily stopped processing water rights permits on the Clark Fork due to a perceived water allocation problem. USGS data indicate that the total flow allocated to Washington and Montana Power Companies exceeded total flow of the Clark Fork in 11 of 12 months of the year. Recent modeling efforts and data indicate this may be the case. MDNRC spoke with Washington Power Co. and decided to commence the permit issuing procedures with permits having broad conditions reflecting existing water rights. MDNRC has also

initiated a long term inventory of water supplies and a study of stream and return flows to the Clark Fork. According to the MDNRC, permits for reserving water supplies via storage (reservoirs) will be favored (to avoid conflicts with downstream users - Washington Power Co.).

Another aspect of the Clark Fork as a possible drinking water supply focuses on the Rattlesnake River. The Mountain Water Co. has water rights to the Rattlesnake River and supplied residents of Missoula with drinking water until the early 1980s when river water use was discontinued due to contamination. The Clark Fork River, however, is not contaminated. Since the Rattlesnake flows into the Clark Fork it would be possible for Mountain Water Co. to take water from the Clark Fork in an amount equal to the amount that the MWC is permitted to draw from the Rattlesnake if the Company can prove that the amount of water would be flowing from the Rattlesnake to the Clark Fork and downstream users would not be impacted. To do this, the Company would have to file for a change in point of diversion with the MDNCR.

Water is available in the Painted Rocks Reservoir for purchase from the State. The MDNRC would handle the sale. This water could then be released into the Bitterroot River and would flow down to the City of Missoula.

The Hungry Horse Reservoir on the Flathead River is a Bureau of Land Management Project with a Federally financed hydro dam which generates hydro power as well as provides headwater benefits (spilling water for downstream users). Discussion in the State is ongoing on reallocation of this water supply. The City of Missoula could develop a contract with the Reservoir to dump water for hydro companies (Montana and Washington Power) and in turn utilize a portion of water on the Clark Fork (originally intended for the hydro companies).

Ground water sources that are potential sources of drinking water and administratively feasible are:

- 1) Renova Equivalent and Precambrian Belt Rocks
- 2) Bitterroot Valley Alluvial Sediments
- 3) Clark Fork Alluvial Sediments

These ground water sources could be preserved for Missoula County use via Montana Code Annotated 85-2-506 and ground water and surface water sources could be reserved and preserved via MCA 85-2-316 with a permit application to the MDNRC.

The City/County of Missoula would reap the greatest benefits if surface and ground water reservation permits were applied for and received from State agencies as well as the Federal Government. This would assure the greatest protection in quality and quantity of drinking water supplies now and in the future.

2.3 ALTERNATIVE SOURCE COST ANALYSIS

According to the Sole Source Aquifer Petition Guidance document developed by EPA, Reference 1 (Step 7, pg. 21:4487) there are two ways that the economic burden of water supply to the community can be assessed. The first is to compare the cost of water use from the aquifer service area to the water use costs paid in nearby communities with approximately the same income level as the population in question. The second method is to determine the annual system cost to a typical user of an alternative potential source. If this cost exceeds 0.4 to 0.6 percent of the mean household income in the area use of the source can be considered economically infeasible. In Missoula, this converts to an acceptable water cost of \$0.35 per 1,000 gallons. MCCHD has assessed the economic burden to the community by utilizing the second method.

Alliance has reviewed the cost analysis presented in Section VII and Appendix F of the MCCHD petition. The comments and summary table (Table 1) are organized according to each cost component analyzed.

Operational Costs

The detailed costs presented under this heading in Appendix F of the petition satisfactorily meet the requirements of Step 7 of Reference 1. The MWC \$3.2 million operational cost is a fixed price component of all development alternatives and must be factored into the cost analyses.

TABLE 1. Review of Alternate Source Development Costs

Type of Cost	MCCHD Capital Costs	Annual Costs	Source	Assumptions Reasonable	Satisfies Petition Guidance Criteria
Admin/Mgmt.		2,483,265	MWC*	yes	yes
Rattlesnake Cr. 1. Multiple Barrier Treatment w/Filtration (10mgd)	3,400,000	599,413	Sanderson, Stewart, Gaston Eng.	yes	yes
2. Improve Exist. System (20 mgd)	2,309,700	347,795	MWC	yes	yes
Conventional Treatment Plan (50 mgd)	15,000,000	2,595,550	MWC	yes	yes
Distribution Improvements	\$40/ft	NA	MWC	yes	yes
Well Field Development	3,600,000	7,331,000	Stone Container Corp. Well Field	yes	yes
Reservoir O'Brien Creek	17,700,000	1,770,000	Montana Dept. of Natural Resources and Conservation	yes	yes

* MWC = Mountain Water Company

Rattlesnake Creek - Multiple Barrier Treatment with Filtration (10 mgd)

This option was analyzed separately in Section VII of the petition as one of two optional use of Rattlesnake Creek. The costing presented is satisfactory according to the guidance in Step 7 of Reference 1. As shown in Table 1, the figures were checked and found to be reasonable. The only discrepancy is the annualization factor used by the applicant. The petitioners used a factor of 0.1 (or 10 years of annual payments) and did not account for interest whereas Reference 3 uses a factor of 0.2. However, use of the annualization factor cited in reference 1 does not significantly change the estimated annualized cost.

Rattlesnake Creek - Improvements on Current System

This alternative is the second use option presented for Rattlesnake Creek. The extent of the costing satisfactorily meets guidance demands and the assumptions made by the petitioners seem reasonable.

Conventional Water Treatment Plant

The numbers derived for the cost of a 50 mgd conventional treatment plant meet the guidance requirements in Step 7 of Reference 1. Comparison with cost figures from Reference 3 show the estimated costs to be reasonable.

Distribution Improvements

The costs for improving the distribution system satisfactorily meet the guidance requirements of Reference 1. The value of \$40/ft presented by the petitioners seems to be reasonable. The estimate of 150 ft. as the average length of water main per household also seems reasonable, but inspection of the water distribution system layout developed by MCCHD to generate this cost would be necessary to more reliably assess this estimate.

Well Field Development

The extent of cost information for the construction of an auxilliary well field satisfactorily meets guidance requirements. The comparison of the Missoula Aquifer to potential development in Bitterroot Valley is acceptable as long as the depths of the wells in the two aquifer are comparable. No mention is made of the expected depth of the wells in Bitterroot Valley. A thorough well cost analysis would require more information on the types of pumps to be used, drilling methods, and materials of construction. The estimate of \$100/ft for laying a 30 inch main is reasonable based upon comparison with figures in Reference 4 (Table 11-3).

Reservoir Developments - O'Brien Creek

The petitioners have satisfactorily presented an estimate of the cost for the development of an earth fill dam reservoir. The petitioners have provided a figure based on an average of similar size reservoirs studied by the Montana Department of Natural Resources and Conservation. As acknowledged on page 149 of the petition, an accurate estimate of reservoir development in an O'Brien Creek site would require a thorough investigation of conditions and obstacles to development. However, the assumptions of the petitioner seem reasonable.

CONCLUSIONS

The Missoula City County Health Department has presented an economic analysis of alternative sources of drinking water in general accordance with guidelines presented in Step 7 of Reference 1 which calls for only approximations of costs for developing each alternative.

In the petition, the petitioner reached the conclusion that all of the alternatives assessed were economically infeasible based on a cutoff cost of \$0.35 per 1,000 gallons of delivered water. This value was developed by multiplying the population of Missoula County by the per capita income of these residents and dividing this amount by the total water usage of the County for a year. Alliance has reviewed the methodology and the inputs to this formula and believes the resultant value is a reasonable approximation of water cost in the community.

For use of Rattlesnake Creek (Multiple Barrier Treatment with Filtration) under Option 1, the figures derived by the petitioner are reasonable and therefore based on the cutoff cost above this alternative is economically infeasible. For use of the Rattlesnake Creek under Option 2 (Improvements on Current System), the petitioner's assumptions for this alternative are valid and this alternative is also economically infeasible.

The two alternative sources requiring conventional water treatment and distribution improvements (Clark Fork River and Bitterroot River) are considered to be economically infeasible. A related alternative source (Hungry Horse Reservoir) which would use the Flathead and Clark Fork Rivers as conduits and would likewise require conventional treatment can also be ruled economically infeasible because of the high costs associated with distribution improvements.

The economic analysis of the Bitterroot Well Field Alternative, and the O'Brien Creek Alternative were both deemed as prohibitively expensive using hypothetical development costs. Alliance has reviewed the assumptions made by the petitioner for both of these alternatives and feels they are valid.

The largest contributor to the overall costs are water distribution system improvements to supply potable water to the approximately 5,000 households in the Missoula County who are not currently supplied by the Mountain Water Company's distribution system. Inherent in the design philosophy of such a system (but not stated) is the assumption by MCCHD that the entire Missoula Aquifer has become unusable and that it is necessary to construct a distribution system that supplies water to all citizens in the County using this aquifer. It is this worst case scenario which accounts for the prohibitive cost of the development of alternate water supplies. This common factor ultimately results in each alternative source having an attendant cost above the specified cutoff cost of \$0.35 per 1,000 gallons of delivered water. This worst case scenario is unlikely but cannot be discounted in determining the costs of alternate supplies. Alliance therefore concludes that the development of alternate water supplies are economically infeasible for this community. The MCCHD petition satisfies all criteria listed in Task E of Work Assignment No. 2-17 for Sole Source Aquifer designation.

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1. U.S. EPA. February 1987. Environmental Protection Agency. Sole Source Aquifer Petitioner Guidance. EPA 9239. Environment Reporter.
2. Means, R.S., 1987. Building construction Cost Data 1987, 45th Annual Addition.
3. U.S. EPA. August 1979. Estimating Water Treatment Costs Volume 1, Summary, EPA 600/2-79-162A. Municipal Environmental Research Laboratory, Cincinnati, OH.
4. U.S. EPA. October 1985. Handbook-Remedial Action at Waste Disposal Sites (Revised). EPA/625/6-85/006. Office of Research and Development, Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, and Office of Solid Waste and Emergency Response, Washington, DC.